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(54) **Oil cooler of plate construction**

(57) An oil cooler consists of an assembly of hollow plates (1) inserted into a housing (2). There are provided between the housing walls (2') and the lateral edges of the plate assembly sealing strips (3) which ensure that cooling water flows completely through the plate assembly, and that there is no by-pass flow between the housing walls and the plate assembly.

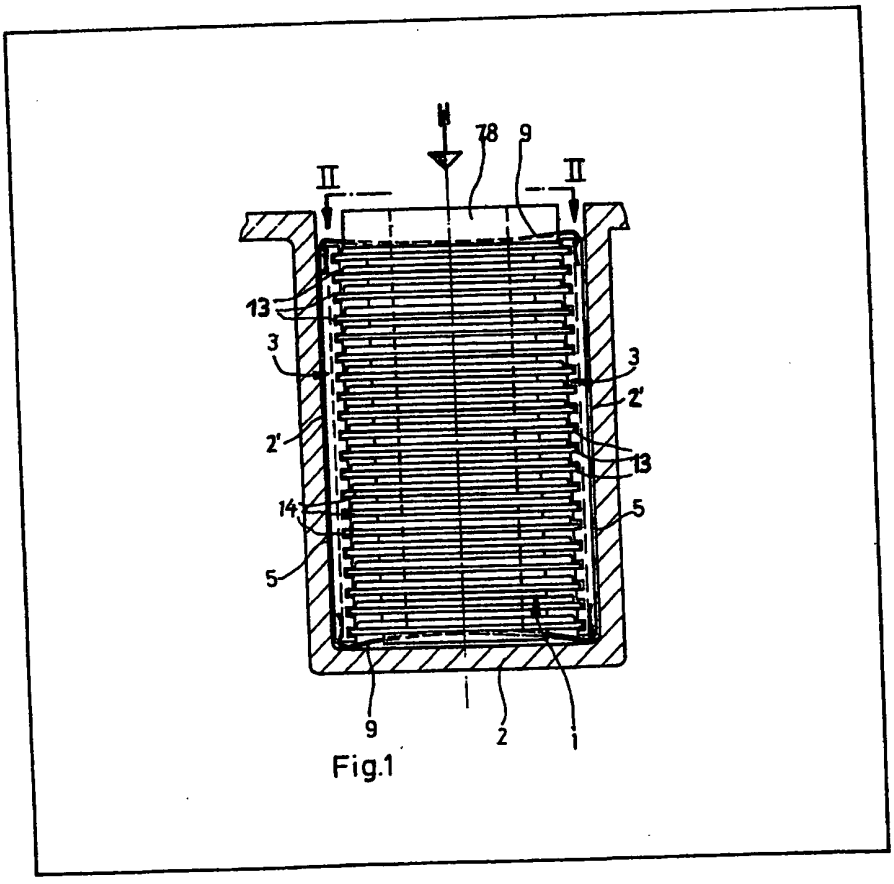

Fig.1

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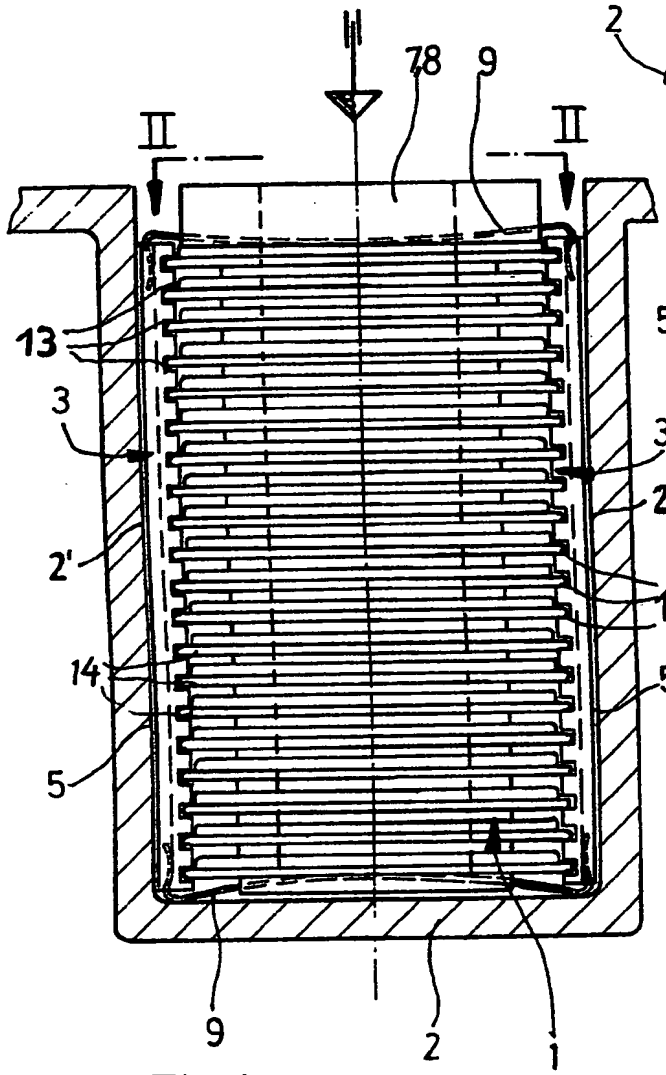

Fig.1

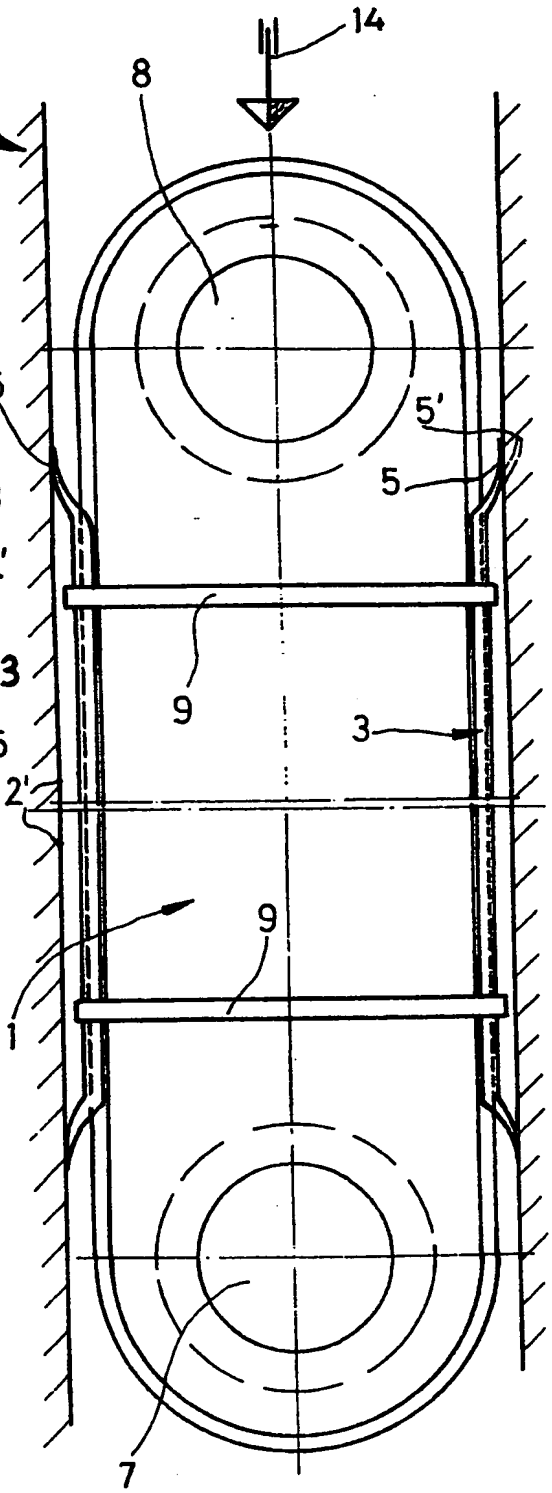

Fig.2

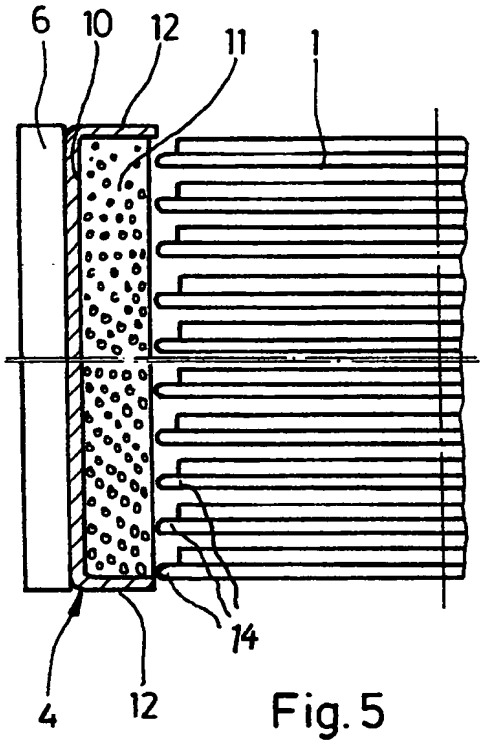

Fig. 5

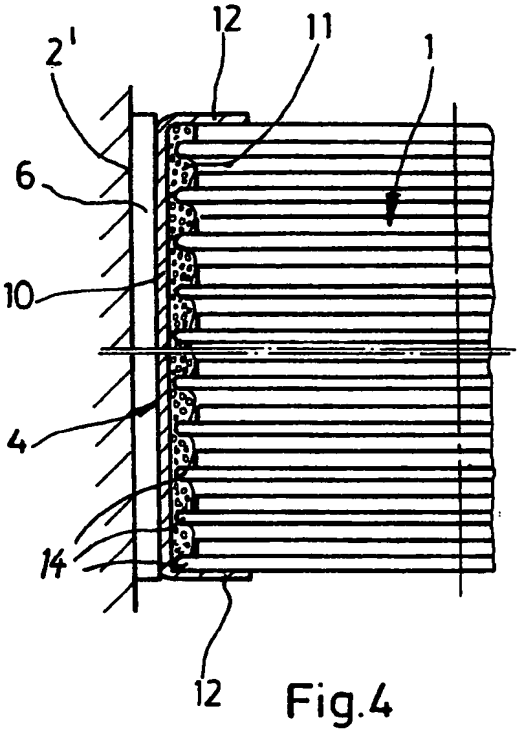

Fig. 4

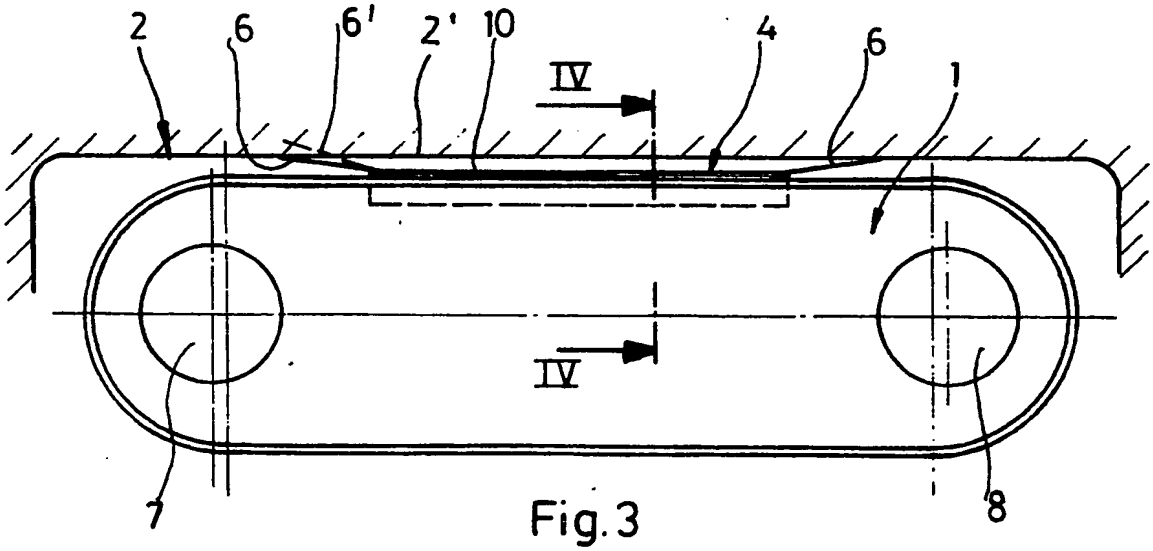

Fig. 3

SPECIFICATION

Oil cooler of plate construction

The invention relates to an oil cooler of plate-like construction having at least one plate assembly provided with a feed and a discharge for the oil which is to be cooled and which is disposed in a housing provided with a water intake and a water outlet.

For production reasons, it is necessary also to maintain between the sides of the plate assembly which extends parallel with the direction of flow of water and which are formed by the edges of the individual plates, and the housing walls opposite them, a space which in practice will constitute a more or less large gap. In this gap, there forms a by-pass flow of water which does not take part in the heat exchange and which thus impairs the efficiency of the oil cooler.

The invention is based on the problem of providing an oil cooler of the type mentioned at the outside but of which the efficiency is enhanced. This problem is resolved in that between those sides of the plate assembly which extend transversely to the direction of water flow, and the housing walls disposed opposite them, there is in each case a sealing strip.

The disposition of a substantially plate-shaped sealing strip prevents a by-pass flow so that the entire quantity of water takes part in the heat exchange.

An expedient further development of the invention envisages the sealing strips being connected to the plate assembly and being inserted into the housing together with the plate assembly. This does not mean that assembly is made more difficult, since the sealing strips can be fitted before the plate assembly is installed.

A particularly advantageous further development of the invention provides for the sealing strips to be provided with flexible lips which are directed towards the housing walls. Thus it is possible to leave a gap between the sealing strips and the oppositely disposed housing walls a structurally advantageous arrangement. This gap is then closed by the flexible lips so that a by-pass flow is still obviated.

It is advantageous if the sealing strips extend in the longitudinal direction of the plates and approximately over the area between the inlet and outlet of the plate assembly. The sealing strips which follow after the inlet and outlet encourage a deflection of the flow towards the middle of the plate assembly so that the liquid flushes better than previously around the back of the inlet or outlet which is at the front in the direction of water flow.

An advantageous further development of the invention provides for the sealing strip to be profiles which are provided with flexible lips at the ends and, on the sides which are towards the plate assembly, with recesses which fit the edges of the plates. As a result of this development, the sealing strips prevent the flow of cooling water in the immediate vicinity of the edges of the individual plates, which has a likewise positive influence on the efficiency of the oil cooler, since the edges have the encircling seam which means that the oil to be cooled does not flow through them and therefore they take only a negligible part in heat exchange.

In the case of another embodiment of the invention, it is envisaged for the sealing strips to be in each case constituted by a plate provided on the side which is towards the plate assembly with an elestic support into which the edges of the plates penetrate. Here, too, where this embodiment is concerned, flow of water in the region of the edges of the individual plates is reduced.

Further features and advantages of the invention will become evident from the ensuing description of embodiments shown in the drawings, and in the sub-claims. In the drawings:

Fig. 1 shows a section through a housing of an oil cooler which is provided with sealing strips to prevent a by-pass flow in the region of the housing walls;

Fig. 2 is a view in the direction of the arrows II-II in Fig. 1, and which is rotated through 90° in respect of an axis extending parallel with the direction of the arrow;

Fig. 3 is a view of a further embodiment of oil cooler according to the invention and having a lateral sealing strip;

Fig. 4 is a partial section on the line IV-IV in Fig. 3, on an enlarged scale, and

Fig. 5 is a partial section similar to that of Fig. 4 with the sealing strip not yet located in its installed position.

The air cooler illustrated has a plate assembly 1 composed of individual plates. The individual plates consist in each case of two stamped-out sheet metal plates having an approximately oval base and connected to each other around their edges by a folded seam. The sheet metal plates enclose a cavity through which passes the oil which is to be cooled.

Disposed in the cavity formed by the two plates are profiled turbulence baffles which provide for an improvement of heat transfer from the oil to be cooled. The individual plates are provided with apertures surrounded by collars and adjacent to which are the corresponding apertures of the next plate, so forming an inlet 7 and an outlet 8 which, in a manner not shown in greater detail, are connected to corresponding feed and discharge connectors. The individual plates are disposed at a distance apart so leaving space for the coolant to flow between the plates, the coolant being in particular cooling water in which there is an anti-corrosive and/or anti-freeze agent. The spacing apart of the plates can be determined, for example, by raised portions stamped into the sheet metal plates. The sheet metal plates of the individual plates as well as the plates themselves can be connected to one another in sealing-tight fashion by hard soldering.

The plate assembly 1 is inserted into a housing 2 which can be either its own housing for the oil cooler or a component part of an engine or gearbox housing or the like. The housing 2 is provided in a manner not shown in greater detail with a water inlet and a water outlet, resulting in a flow of cooling water being created between the plates of the plate assembly 1, the cooling water flow being preferably in the longitudinal direction of the plates, as illustrated by the arrow 14 in Fig. 2.

For technical reasons, it is necessary for the plate assembly 1 to be so inserted into the housing 2 that

there is also transversely of the direction of the flow of the water (arrow 14) a space between the plate assembly 1 and the oppositely disposed walls 21 of the housing 2. To prevent a by-pass flow of cooling water becoming established through the resultant gap, since such cooling water would not take part in the heat exchange, sealing strips 3 are disposed between those sides of the plate assembly which extend parallel with the direction of water flow (arrow 14) and the oppositely disposed wall 21 of the housing 2. The sealing strips 3 are disposed on the plate assembly 1 so that the plate assembly 1 can be inserted into the housing together with the sealing strips 3. The sealing strips 3 are so constructed that there is also left between them and the walls 21 of the housing 2 a space which is, however, bridged by lips 5 which bear in sealing-tight manner against the walls 21 of the housing 2.

As can be seen particularly from Fig. 1, the sealing strips 3 consist of plate-like synthetic plastic profiles which, on the surfaces towards the plate assembly 1, are provided with groove-like recesses 13 which engage around the edges 14 of the folded seam joining the plates of the plate assembly 1. The lips 5 are integrally moulded on the plate-like profiles and these consist of flexible material, at least in the region of the lips 5. These lips 5 bear with some initial tension against the walls of the housing 2. Fig. 2 shows in broken lines the relieved position 5' of the lips 5 which ensure that no by-pass flow can occur between the sides of the plate assembly 1 and the walls of the housing 2, so that the entire quantity of water must participate in the heat exchange. Since the sealing strips 3 also fit around the edges of the individual plates, the cooling water flow is displaced farther towards the middle of the plates of the plate assembly 1, which is advantageous because no oil which is to be cooled can flow in the edges of the individual plates, so that these edges take only a neglible part in the heat exchange.

In the case of the embodiment shown in Figs. 1 and 2, the sealing strips are held on the plate assembly by U-shaped spring clamps 9. It is also possible for the sealing strips to be secured to the plate assembly at one or more points by adhesion, so that spring clips 9 become unnecessary. The sealing strips 3 are so disposed that they mask virtually the entire area of that part of the sides of the plate assembly 1 which is located between the inlet 7 and outlet 8.

In the case of the embodiment shown in Figs. 3 to 5, there is provided an already-described plate assembly 1 which is likewise inserted into a housing 2 in such a way as to leave a space. Also with this embodiment, there is disposed between the sides of the plate assembly 1 and the walls 21 of the housing 2 a sealing strip 4 which prevents a by-pass flow forming between the walls of the housing and the sides of the plate assembly 1. The sealing strips 4 which is, of course, disposed on each side of the plate assembly consists of a plate 10 which on its side which is towards the plate assembly 1 is coated with a rubber-elastic material, particularly a foamed material 11, for example the material known by the trade mark "Moltopren". This material 11 is expediently glued or vulcanised onto that face of the plate 10 which is towards the plate assembly 1. The edges 12 of the plate which extend in the direction of flow of the coolant are angled over towards the plate assembly 1 and grip this plate assembly top and bottom when the sealing strip is in its installed state (Fig. 4). In the installed state of the sealing strip, the edges 14 of the individual plates of the plate assembly 1 which are formed by the encircling folded seam penetrate the elastic support 11 of the plate 10 so that the edges of the plates which do not participate in the heat exchange are completely masked. The edges 12 of the plate 10 are expediently glued to the plate assembly 1. Of course it is also possible to secure the sealing strips 4 to the plate assembly by spring clips 9, according to Figs. 1 and 2.

The installed sealing strip 4 (Fig. 4) likewise maintains a space from the oppositely disposed wall of the housing 2, the space being bridged by lips 6 provided on the ends of the plate 10. The lips 6 expediently consist of a formed spring plate which is secured to the plates 10, for example by rivets or the like, and which can be inserted into the housing 2 together with the sealing strips 4 with only a slight deformation. The relieved position 6' of the lips 6 is shown in the left-hand half of Fig. 3. Here, too, where this embodiment is concerned, the sealing strips 2 extend almost over the entire area of the plate assembly which is disposed between the inlet 7 and the outlet 8.

It is also possible for plate assemblies 1 to be disposed parallel with and alongside each other in a common housing 2. By reason of the provision of sealing strips 3 or 4 on the sides of the plate assemblies 1, chambers are formed in the common housing in which the plate assemblies are disposed, without any need for the housing to be provided with partitions. Then, guided currents of cooling water are obtained without any possibility of by-pass flows forming.

CLAIMS

1. Oil cooler of plate-like construction having at least one plate assembly provided with a feed and a discharge for the oil which is to be cooled and which is disposed in a housing provided with a water intake and a water outlet, characterised in that respective sealing strips (3, 4) are disposed between those sides of the plate assembly (1) which extends parallel with the direction (14) of water flow and oppositely disposed housing walls (2).

2. Oil cooler according to Claim 1, characterised in that the sealing strips (3,4) are connected to the plate assembly (1), with which they are inserted into the housing (2).

3. Oil cooler according to Claim 1 or 2, characterised in that the sealing strips (3, 4) are provided with flexible lips (5, 6) which are directed towards the housing walls.

4. Oil cooler according to one of Claims 1 to 3, characterised in that the sealing strips (3, 4) extend in the longitudinal direction of the plates and approximately over the region between the inlet (7) and outlet (8) of the plate assembly (1).

5. Oil cooler according to one of Claims 1 to 4, characterised in that the sealing strips (3) are profiles provided with flexible lips (5) at their ends while on the sides which are towards the plate assembly (1) they

have recesses (13) which match the edges of the plates.

6. Oil cooler according to one of Claims 1 to 4, characterised in that the sealing strips (4) are in each case formed by a plate (10), which, on the side which is towards the plate assembly (1) are provided with a resilient support (11) into which the edges of the plates penetrate.

7. Oil cooler according to Claim 6, characterised in that the ends of the plates (10) are provided with flexible lips (6) which are directed towards the housing walls.

8. Oil cooler according to Claim 6 or 7, characterised in that those edges (12) of the plates (10) which extend in the direction of flow (14) of the water are angled over and engage around the plate assembly (1).

9. Oil cooler according to Claim 8, characterised in that those edges (12) of the plate which engage around the plate assembly (1) are secured to the plate assembly (1) by adhesion.

10. Oil cooler according to one of Claims 1 to 9, characterised in that the sealing strips (3, 4) have resilient clamping elements (9) by which they are held on the plate assembly (1).

11. Oil cooler according to one of Claims 1 to 10 having at least two plate assemblies disposed in a common housing, characterised in that the mutually adjacent sides of the plate assemblies (1) are provided with sealing strips (3, 4) which form a partition.

12. Oil cooler according to one of Claims 1 to 10 having at least two plate assemblies disposed in a common housing, characterised in that between the adjacent sides of the plate assemblies (1) there are sealing strips which on both sides accommodate the edges of the plate assemblies (1).

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